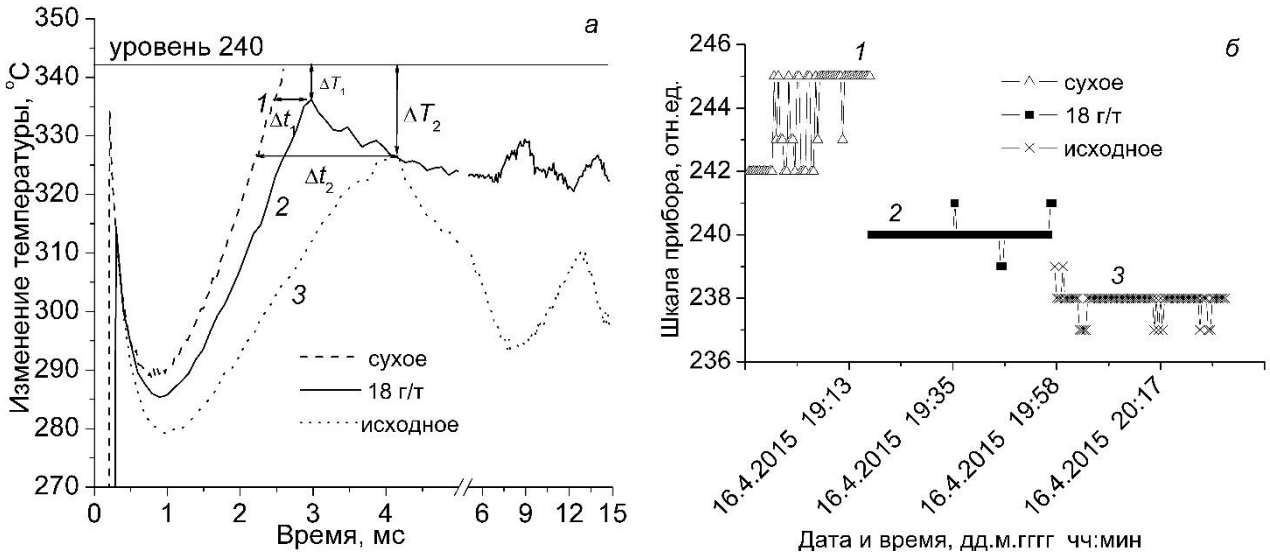

Рис. 1. Измерение влагосодержания в образцах трансформаторного масла методом экспресс-термоконтроля: *а* – типичные термограммы при фиксированном уровне нагрева «240» в осушенном (1), с влагосодержанием 18 ppm (2) и исходном (товарном) (3) образцах; *б* – сопоставление уровней нагрева, соответствующих началу вскипания данных образцов, при пошаговом увеличении характерной температуры опыта.

1. Шангин В.В., Волосников Д.В., Сафонов В.Н. и др. Приборы, 5 (2012).
2. Волосников Д.В., Скрипов П.В., Вестник ТГТУ, 14, 1, 61 (2008)
3. Шангин В.В., Волосников Д.В., Старостин А.А. и др. Тепловые процессы в технике,**5**, 9 (2012).
4. Артемьев Г.А., Волосников Д.В., Гурашкин А.Л. и др., Вестник ТГТУ, **18**, 4 (2012)

THE INFLUENCE OF HIGH PRESSURE ON THE COMPLEX PERMITTIVITY OF THE PEROVSKITE – LIKE PHASES $CaCu_3Ti_{4-X}V_XO_{12}$

Mirzorakhimov A.A.[1*], Melnikova N.A.[1], Kadyrova N.I.[2], Zaynulin Yu.G.[2], Babushkin A.N.[1]

[1)] Ural Federal University, Yekaterinburg, Russia

[2)] Institute of Solid State Chemistry of the Ural Branch of the Russian Academy of Sciences, Yekaterinburg, Russia

*E-mail: xomi4ev@mail.ru

Cubic perovskite-like oxide $CaCu_3Ti_4O_{12}$ (CCTO) is well known as material with giant permittivity (10^4–10^5) which remain sensibly constant over a wide temperature range [1]. The causes for high dielectric permittivity are not fully studied yet, and are currently being a case for numerous researches. The aim of this work is to investigate the effect of external influences (high pressure, vanadium doping) on the electrical properties of the high pressure perovskite–like phases $CaCu_3Ti_{4-x}V_xO_{12}$. One of the

methods to elucidation high permittivity is revealing the impact of external influences on the dielectric properties of materials.

Materials was obtained by thermobaric method; synthesis are described in detail in [2]. Electric properties were measured by method of impedance spectroscopy with Solartron 1260A. The method receiving high pressures is in detail described in [3].

Increase in vanadium content $CaCu_3Ti_{4-x}V_xO_{12}$ conductivity activation energy decreases, the conductivity increases and conserve high dielectric constant values. Withal, the conductivity is independent of the frequency in the range from 100 Hz to 1 MHz, and the dielectric constant remains practically constant in a frequency range from 10^3 to 10^7 Hz and vanadium doping maintains high values of complex permittivity (Fig. 1). The logarithm of resistance is a nearly linear function of pressure in the pressure ranges 9–30 GPa [5]. The preliminary assessment of pressure effects on permittivity based on the capacity of the sample cell indicates high values (10^3) of permittivity in the investigated range of pressures, and the absence of dispersion in the frequency range from 100 Hz to 10^7 Hz. Our study serves as a window to an understanding of the process origination giant dielectric constant.

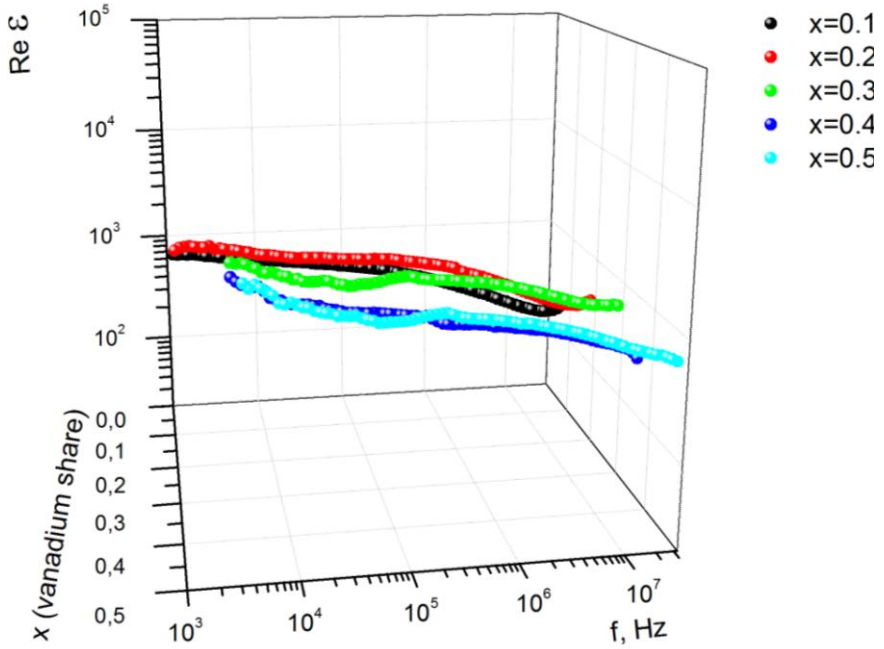

Fig. 1. Frequency dependencies of the dielectric constant of $CaCu_3Ti_{4-x}V_xO_{12}$

This work was supported by the RFBR (projects No. 16-02-00857 and No. 15-03-00868).

1. Subramanian M. A., et al., J. Solid State Chem. V. 151, P. 737, (2000).
2. Kadyrova N. I., et al., Russian Journal of Inorganic Chemistry, 53, P. 1542-1545, (2008)
3. Babushkin A.N., et al., J.Phys. Condens. Matter. 5, P. 8659-8664, (1993).
4. Melnikova N.V., et.al., Journal of Physics: Conference Series 653, 012099, P. 1-4 (2015).
5. Mirzorakhimov A.A., et.al. // Phys. in Higher Educ. 2015. V. 21, № 1C, P. 31-33, (2015).